PRLF-S0010

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Additional Listing Support Analyses
for the
Petroleum Refining Listing Determination

U.S. Environmental Protection Agency
Office **of** Solid Waste
Washington, D.C. **20460**

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CONTENTS

1.0 Calculation of Municipal Landfill Active Life

Based on the municipal landfill survey conducted by OSW in 1986, as reported in "National Survey of Solid Waste (Municipal) Landfill Facilities", EPA/530-SW88-034, September 1988:

> **Average Age** of a facility (from the year waste was first placed in the landfills to the time of survey)
> = 18.6 years (including closed and active units)
>
> **Average Remaining Life** of a facility (from the time of survey to the year landfills were expected to be filled)
> = 21.3 years (including active and planned units)

	Municipal Landfill Facilities		
	Closed Units	Active Units	Planned Units
Number of Reported Units	3,152	6,585	3,847
Percentage of Total	23%	49%	28%

Average Year Waste First Placed	Time of Survey	Average Year Unit to Be Filled
1967	1986	2007

Closed Landfills, $\mathbf{N_C}$
? <------------------------------> Closed
Life Frame, $\mathbf{L_C}$

Active Landfills, $\mathbf{N_A}$
? <....................................... > ?
Life Frame, **LA**
$\mathbf{L_{A1}}$ | $\mathbf{L_{A2}}$

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Planned Landfills, N,
Opened <---------------------------> ?
Life Frame, L,

ASSUMPTIONS:

L, = Average Life Frame of Closed Landfill Units

$\mathbf{L_A}$ = Average Life Frame of Active Landfill Units
= $\mathbf{L_{A1}} + \mathbf{L_{A2}}$

$\mathbf{L_{A1}}$ = Average Age of Active Units

$\mathbf{L_{A2}}$ = Average Remaining Life of Active Units

$\mathbf{L_P}$ = Average Life Frame of Planned Units

$\mathbf{L_C}$ = **L,** = **L,**

N, = (No. of Closed Units)/(Total No. of Reported Units)
= 23%

N, = (No. of Active Units)/(Total No. of Reported Units)
= 49%

N, = (No. of Planned Units)/(Total No. of Reported Units)
= 28%

Average Age = (**L,** * $\mathbf{N_C}$ + $\mathbf{L_{A1}}$ * $\mathbf{N_A}$) / ($\mathbf{N_C}$ + $\mathbf{N_A}$)
= 18.6 years

Average Remaining Life = ($\mathbf{L_{A2}}$ * $\mathbf{N_A}$ + **L,** * $\mathbf{N_P}$) / (N, + $\mathbf{N_P}$)
= 21.3 years

CALCULATIONS:

Equation (1):
(L, * 23% + $\mathbf{L_{A1}}$ * 49%) / (23% + 49%) = 18.6 years

Equation **(2):**
(L, * 49% + $\mathbf{L_P}$ * 28%) / (49% + 28%) = 21.3 years

Equation (3):

$$\mathbf{L_C = L_P = L_A}$$
$$= (\mathbf{L_{A1} + L_{A2}})$$

Solve the above equations:

$\mathbf{L_{A1}}$ = 13.3 years

$\mathbf{L_{A2}}$ = **16.5** years

Therefore,

$$\mathbf{L_C = L_A = L_P} = \mathbf{L_{A1}} + LA2$$
$$= 13.3 \text{ years} + 16.5 \text{ years}$$
$$= \mathbf{29.8} \text{ years}$$

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2.0 ANALYSIS OF POTENTIAL IMPACT OF THE HEADWORKS EXEMPTION FOR CRUDE OIL TANK SLUDGE

EPA proposed to modify the definition of hazardous waste on November 20, 1995 with respect to certain wastes generated by the petroleum refining industry. One of the these wastes considered for listing as hazardous waste was sediment from the storage of crude oil. During storage tank turnaround, EPA observed water washing of the tank, resulting in a wastewater stream that contains sediment to be listed as K169. Industry also reported through the Section 3007 survey four facilities flushing storage tank sludge to wastewater treatment. EPA proposed to cover discharges of CSO sediment waters under the existing headworks exemption (60 FR 57781), and proposed a similar exemption for crude oil tank sediment if listed.

Public comment was submitted regarding the appropriateness of the proposed headworks exemption. The Notice of Data Availability presented EPA's analysis of the potential risks associated with the discharge of crude oil tank sediment (COTS) to on-site wastewater treatment. The purpose of this document is to describe the Agency's analysis of the similar worst case scenario of direct discharge to wastewater treatment of K169, as reported by four facilities in the 1992 Section 3007 survey.

EPA assessed the impact of discharging crude oil tank sludge sediment and wastewaters to a refinery wastewater treatment plant on both the wastewater reaching an aggressive biological treatment (ABT) surface impoundment/equalization pond, and the ABT sludge generated in such a unit. The primary constituents of concern in this residual are PAHs and benzene, as determined by the risk assessment conducted in support of the proposed rule and NODA. Volatilization pathways were not considered due to the low volatility of the PAHs of concern and the fact that low benzene releases likely would be subject to benzene NESHAPS controls.

Description of Management Practice

Of the 172 refineries that responded to Section 3007 Survey sent by EPA, four facilities reported discharging its crude oil tank sediment to its on-site wastewater treatment plant in 1992 (note that 61 facilities reported generating any crude oil tank sediment in that year). The industry-wide 1992 sludge volume undergoing this management practice was reported to be 2,118 metric tons. The highest quantity reported by a single facility is 2,115 metric tons. To assess the potential impact on the wastewater treatment system, some estimate of wastewater generated at the facility **was** needed. The facility reported in the 1983 Section 3007 survey that it typically treated 1.13 million gallons per day of wastewater. The crude oil sludge discharge time period was assumed to be ***6*** weeks, a typical tank turnaround period.

EPA assumed the wastewater treatment system consists of primary treatment (i.e., API separators and DAFs), secondary treatment (i.e., aggressive biological treatment) and polishing. The secondary and polishing units are assumed to be surface impoundments, while the primary treatment units are tanks. Further justification for this treatment train is provided in the CSO sediment analyses.

The disposition of the crude oil sediment in the wastewater treatment system is assumed to consist of the following steps:

- Primary treatment in the API separator and DAF units. DAF removal of solids is estimated to be 70 to 90 percent without polymer addition', and averaging 97 percent with polymer addition. EPA was unable to identify a reference for solids removal for the API separator. It was assumed that the solids removal rate of the two units would be comparable to the high end effectiveness of the DAF alone.

- Aggressive biological treatment (ABT) and clarification in surface impoundments, achieving PAH-specific biodegradation and sedimentation rates predicted in a mass balance analysis conducted by ERM-Southwest.[2]

Estimates of Wastewater Concentrations

EPA conducted sampling and analysis of ***6*** samples of crude oil tank sediment. The analyses included total and TCLP characterization for a broad array of volatile and semi-volatile organics and toxic metals. The risk assessment for the November 20, 1995 proposed rule and April **8,** 1997 NODA found risk to be associated with 6 polynuclear aromatic hydrocarbons (PAHs) and benzene. Table 1 summarizes the analytical results for these contaminants.

The Agency's analytical results show that many of the toxicants of concern in crude oil tank sediment appear to be highly immobile, with none of the PAHs being detected in the TCLP leachate samples. The solubilities of these contaminants are generally well below the TCLP method's quantitation **limits.**[3] The average benzene leachate concentration was 679 ug/L.

Table 1. Crude Oil Sediment Characterization

'Warren Viessman, Jr. and Mark J. Hammer. "Water Supply and Pollution Control". Fifth Edition. Section 13.8 Description of Dissolved-Air Flotation, "Without polymer addition, solids capture is 70-90%. However removal efficiency increases to a mean of 97%, with polymer dosage of approximately 10 lb/ton of dry suspended solids."

*Letter from Robert E. Robinson, P.E., ERM-Southwest, to Kyle B. Isakower, American Petroleum Institute, dated November 13, 1995.

[3]Quantitation limits in the 1995 Listing Background Documented were reported to be 100 ug/L. Because the GC/MS instrumentation used for Method 8270B TCLP analysis is sufficiently sensitive to detect on-column concentration of 1 ng, or 10 ug/L in the leachate, it is reasonable to state that the actual TCLP PAH detection limits more closely resemble the method detection limits (MDLs) of 10 ug/L. The MDLs represent the minimum concentration of a substance that can be measured and reported with 99% confidence the analyte concentration is greater than zero. Thus, all PAH detection limits can be reported as <10 ug/L.

Constituent	Average Total Constituent Concentration (mg/kg)	Average TCLP Concentration mg/L	Solubility (mg/L)
Benz(a)pyrene	12.3	ND	0.00194
Dibenz(a,h)anthracene	2.0	ND	0.00067
Benz(a)anthracene	203	ND	0.0128
Indeno (1,2,3-cd)pyrene	8.1	ND	0.0107
Benzo(b)fluoranthene[1]	**5.7**	ND	0.0043
Benzo(k)fluoranthene	5.7	ND	0.00094
Benzene	58.7	0.679	1,780

[1] **The average total benzofluoranthene concentration was divided by** *two* **to estimate the concentrations of the b and k isomers.**

The PAHs are relatively insoluble in water and are not expected in the aqueous phase--this is consistent with the lack of detection in the TCLP tests (down to 10 ppb) as shown in Table 1. These compounds are unlikely to be a threat in groundwater due to their insolubility and their propensity to adsorb to any organic material. However, as a worst case, EPA assumed that the PAHs are in solubility equilibrium with the tank wash water. This analysis may overstate tank wash water concentrations due to the presence of oils and oily sludges, to which the PAHs may be preferentially drawn, resulting in wastewater concentrations somewhat below solubility levels. Use of a similar solubility approach for benzene to estimate wastewater concentration would violate mass balance requirements, (i.e., there is not enough benzene present in the waste to reach the solubility limit). Instead, the TCLP results were used to estimate the equilibrium state between benzene in the crude oil tank sediment and the water column.

Table 2 presents the wastewater analysis. The third column shows the solubility limits assumed to be reached in the wash water. The wash water volume[4] is then diluted with other process wastewaters at the headworks as predicted in column four of Table 2. (PAH contributions from other sources are ignored as a means of isolating the impact associated with crude oil tank sludge dumping).

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[4]**EPA's contractor** (DPRA) **conducted a phone survey of 12 refineries regarding typical tank wash water volumes in January 1997. Of the nine responsive refineries, three facilities reported generation** of **CSO tank wash waters, with a median** of **27,500 gal/tank.** For this **analysis the same volume** of **wastewater was assumed to rinse the crude oil tank.**

The ABT unit is assumed to provide PAH removal from influent wastewater at levels comparable to those observed by API and documented by ERM (see Attachment 3). Benzene removal is assumed to be comparable to levels observed by API (see Attachment 6). The calculated results are presented in column five of Table 2.

The last two columns of Table 2 present cancer slope factors and calculated risk levels. As a worst case bounding analysis, the risk levels assume migration of the ABT effluent through the subsurface of the ABT and equalization impoundments to a nearby drinking water well with no intervening dilution. The risk levels were calculated from the appropriate cancer-slope factors (CSF) using the following equation and assumptions:

Risk = (I x ED x EF x CSF) / (BW x AT x 365), where

I = consumption rate, 1.4 L/day x concentration in media (mg/L)
ED = exposure duration = 9 years
EF = frequency, 42 days/year (6 weeks/year)[5], one tank turnaround and sediment dumping per year
BW = 70 kg adult
AT = averaging time, 70 years.

The results of this analysis shows that none of the PAHs or benzene are likely to exceed their associated health-based number (HBNs) for ground-water ingestion.

Estimates of Sludge Concentrations

In the Background Document for the April 1997 NODA, EPA estimated that the concentrations of PAHs in ABT sludge would be from 800 to 79,000 times less than their corresponding concentrations in CSO sediment. EPA conducted a similar comparison for crude oil tank sludge, using a similar approach and using the worst case conclusions of a facility discharging 2,115 MT of COTS to wastewater treatment. This comparison is given in Table 3. Table 3 shows the levels of PAHs in ABT sludge to be comparable to the levels of PAHs in CSO sludge. For benzene, the ratio of benzene in ABT sludge to its level in COTS is 2,300.

[5] 350 dayslyear is the standard assumption used in the full risk assessment. Six weeks reflects the assumed, tank turnaround period.

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Table 2. Solubility-Pre[illegible] W						
Constituent	Average Total Constituent Conc. (mg/kg)	Solubility as Wash Water Conc. (ug/L)	Headw[illegible]s Conc. (u[illegible])*	ABT Effluent Conc. (ug/L)**	Cancer Slope factor (mg/kg/day)$^{-1}$	Ground-water Risk
Benz(a)pyrene	12.3	1.94	1.12e-03	1.57e-05	7.30	3.39e-11
Dibenz(a,h)anthracene	2.1	0.67	3.88e-04	2.33e-05	8.10	5.61e-11
Benz(a)anthracene	11.5	12.8	7.42e-03	2.23e-05	1.10	7.24e-12
Indeno (1,2,3-cd)pyrene	8.1	10.7	2.90e-02	6.37e-04	0.40	1.89e-10
Benzo(b)fluoranthene	5.7	4.3	2.4[illegible]e-03	2.4[illegible]e-05	1.20	8.82e-12
Benzo(k)fluoranthene	5.7	0.94	5.44e-04	1.31e-05	0.15	5.78e-13
Benzene	58.7	679	3.93e-01	1.50e-03	0.03	1.33e-11
Total Risk						3.09e-10

*Headworks concentrations were calculated using a crude oil tank wash water discharge of 27,500 gallons over 6 weeks to a WWT treatment system with a flow rate of 1.13 million gallons per day. For benzo(a)pyrene, for example, the calculations are: 1.94 ug/L x 27,500 gal/6 weeks x week/7 days x day/1.13E+06 gal = 0.00112 ug/L.

* ABT effluent concentration = influent concentration x (1- removal rate). Removal rates are presented in Table 4.

Table 3. Calculation of Dewatered ABT Sludge Concentration

Constituent	Average Total Conc. (mg/kg)	Loading to WWT Headworks (g/day)[1]	Loading to ABT Influent (g/day)[2]	Loading to ABT Sludge (g/day)[3]	Conc. In ABT Sludge (mg/kg)[4]	Ratio of COTS to ABT Sludge Conc.	Conc. in ABT sludge from CSO analysis (mg/kg)
Benz(a)-pyrene	12.3	619	62	4.376	[illegible] 123	100[illegible]	[illegible] 1[illegible]7
Dibenz(a,h)-anthracene	2.1	106	11	1[illegible]37	0[illegible]29	7[illegible].4	0[illegible]46
Benz(a)-anthracene	11.5	579	58	0.20[illegible]	0.0057	2,018	0[illegible]09
Indeno(1,2,3-cd)pyrene	8.1	408	41	1.673	0.0 .7	172	Not [illegible]valuat[illegible]
Benzo(b)-fluoranthene	5.7	287	29	0.893	[illegible]25	[illegible]8	0[illegible]15
Benzo(k)-fluoranthene	5.7	287	29	0.0287	0.0008	7,125	<0.001
Benzene	58.7	2,956	296	0.888	0.025	2,349	<0.001

[1] The daily PAH loading to Headworks were estimated using the PAH concentration in the COTS and assuming the entire waste was discharged to the wastewater treatment system over 6 weeks; for example, for benz(a)pyrene, the calculation was:
12.3 mg/kg x 2,115,000 kg/6 weeks x g/1000 mg x week/7 days = 619 g/day

[2] Loading to ABT Influent = 10 percent of headworks loading, assuming 90% solids removal in API/DAF

[3] Loading to ABT sludge=Influent loading times ERM adsorption rate (presented in CSO analysis, ranges from 94.0 to 99.7%).

[4] Sludge Concentration=Sludge loading in g/day x day/9,400 x gal/3.78 L x 1e+03mg/g. (The median ratio of influent to sludge rate was 120, according to ERM and API. This median was divided into the modeled refinery's influent rate of 1.13 million g/d to estimate the ABT sludge rate of 9,400 gal/d.)

3.0 Offsite Subtitle D Landfills Used for Disposal of Petroleum Refining Wastes

<u>Introduction</u>

The purpose of this analysis is to determine the likelihood of industrial D landfill and municipal landfill management of refinery wastes. Offsite Subtitle D landfills (including both industrial and municipal) were used for the disposal of many of the 29 petroleum refining residuals of concern in 1992. Both municipal and industrial Subtitle D landfills are used for disposal although the precise quantity managed in each type of unit has not been summarized (for example, the 1995 Listing Background Document, F-95-PRLP-S0003, combines wastes managed in municipal and industrial D landfills in one category). This analysis first uses the petroleum refining data base to determine all offsite Subtitle D landfills reportedly used for the disposal of any residual of concern in 1992. Next, the status of each landfill was verified using three other sources. In some cases, either conflicting information or no information was found from the verification check.

<u>Methodology</u>

A subset of the petroleum database was produced to show all petroleum refinery residuals of concern generated and shipped off-site for management in Subtitle D and Subtitle C landfills in 1992. This list is identical to that developed for a FOIA request in 1996 ("Printout of Disposal Offsite Subtitle C or D Landfills or Land Treatment Units in 1992", dated February 21, 1996). The data set, initially produced in ASCII format, was imported into Microsoft Access to facilitate data manipulation and retrieval. Three queries were then built to segregate industrial D, Subtitle C, and Municipal Landfills. Upon examination of the data produced by the queries, it was found that many sites appeared as more than one type of landfill (e.g., one refinery reported a disposal unit as a municipal landfill while a second refinery reported the identical site as an industrial D landfill). Thus, three more queries were developed. These three queries cross referenced each of the original lists to determine which sites appeared on more than one list.

The results of these six queries are listed below. Each landfill was then verified when possible using the three sources listed below. Specifically, each landfill was checked against each of the three sources and the results shown in the rightmost column of the lists:

- Industrial *C* - indicates the landfill was found in BRS and accepts hazardous wastes.
- Industrial D - indicates the landfill was found in the "List of Industrial Waste Landfills and Demolition Waste Landfills."
- Municipal - indicates the landfill was found in the "List of Municipal Solid Waste Landfills."
- Unverified - indicates the landfill was not present in any of these sources.

- The table lists other notes as appropriate to indicate obvious misreporting.

Table 1 is a summary of the initial queries and subsequent verification. If conflicting information on landfill status was found from the initial database queries or subsequent verification step, the particular landfill was assumed to have “mixed” status.

Landfill Type	Number of Landfills
Industrial D	23
Municipal	31
Subtitle C	17
Mixed Industrial D and Municipal	20
Mixed Subtitle D and C	15
Total Number of Subtitle D and C Landfills Used in 1992	106

Verification Sources

1. 1995 Biennial Reporting System database.
2. “List of Municipal Solid Waste Landfills,” U.S. **EPA** June 1996.
3. “List of Industrial Waste Landfills and Demolition Waste Landfills,” prepared for the U.S. **EPA** by Eastern Research Group, Inc. September 30, 1994.

Conclusion

Both industrial D landfills and municipal landfills were used for the disposal of refinery wastes in 1992. Based on Table 1, an estimated 31 municipal landfills and 23 industrial landfills were used in 1992. Of the 31 municipal landfills, 19 were verified and 12 remain unverified. Of the 23 industrial D landfills, 4 were verified and 19 remain unverified. Therefore the lack of verification reflects potential uncertainty in the categorization of these landfills.

Conflicting information among sources reflects additional uncertainty in the data. While one refinery may indicate a particular landfill is an industrial D landfill, another may give the same location a different categorization. Similar observations occurred in the verification sources. This analysis does not attempt to resolve such conflicts, so that these particular locations may in fact have different types of units; alternatively, one or more refineries may have reported the classification incorrectly.

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Industrial D Landfills

NAME	*CITY*	*STATE*	*VERIFICATION*
BFI	SORRENTO	LA	unverified
BFI	SULPHUR	LA	Industrial C
BFI	ERIE	MI	Municipal
BFI	BILOXI	MS	unverified
BFI	PONCE	PR	Industrial D
BFI	MEMPHIS	TN	Municipal
CENTRAL SANITARY	PIERSON	MI	Municipal
CONSERVATION SERVICES	DENVER	CO	unverified
CONSERVATION SERVICES	BENNETT	CO	unverified
COUNTY SANITATION	WHITTIER	CA	unverified
COUNTY SANITATION	WALNUT	CA	unverified
CRI-MET/AMAX	BRAITHWAITE	LA	Not a landfill
EAST CARBON	EAST CARBON	UT	unverified
EVERGREEN LANDFILL	NORTHWOOD	OH	Municipal
GRAND CENTRAL	PEN ARGYL	PA	Municipal
GREEN ACRES	TECUMSEH	OK	Municipal
LAIDLAW ENVIRONMENTAL	ROXANA	IL	unverified
LAIDLAW ENVIRONMENTAL	TERRE HAUTE	IN	unverified
LAIDLAW ENVIRONMENTAL	WHITE CASTLE	LA	Industrial D
LAIDLAW ENVIRONMENTAL	LAPORTE	Tx	unverified
MAGNOLIA LANDFILL	MONROE	LA	unverified
PECAN GROVE SANITARY	PASS CHRISTIAN	MS	Municipal
PEORIA DISPOSAL	PEORIA	IL	Municipal
PRAIRIE VIEW RECYCLING	WYATT	IN	Municipal
PROTECT0 PROTECCION	PENUELAS	PR	Industrial D
REPUBLIC ENVIRONMENTAL	DAYTON	OH	unverified
RESOURCE RECOVERY	CHERRYVALE	KS	unverified
ROBSTOWN LANDFILL	ROBSTOWN	Tx	unverified
SO. OK WASTE DISP.	TISHOMINGO	OK	Municipal
SOUTH CHAIN OF ROCKS	GRANITE CITY	IL	unverified
TWIN BRIDGES RECYCLING	DANVILL	IN	Municipal
VENICE PARK DVLPMNT.	VERNON	MI	Municipal
W. CONTRA COSTA	RICHMOND	CA	Municipal
WASTE MANAGEMENT INC.	AULD	CO	unverified
WASTE MANAGEMENT	SIBLEY	MS	unverified
WESTERN WASTE	CONROE	Tx	Industrial D
WESTERN WASTE	NEW BOSTON	Tx	unverified

WESTERN WASTE, INC	TEXARKANA	AR	unverified

Municipal Landfills

NAME	CITY	STATE	VERIFICATION
ANGUILLA SANITARY	ST CROIX	VI	Municipal
ARTESIA CITY LANDFILL	ARTESIA	NM	Municipal
BFI	BROKEN ARROW	OK	unverified
BFI	LOWELLVILLE	OH	Municipal
BFI PINE BLEND SANITARY	INVER GROVE	MN	Municipal
BROOKS LANDFILL	WICHITA	KS	unverified
BUTLER COUNTY LANDFILL	EL DORADO	KS	Municipal
CITY ENVIRONMENTAL	CARLETON	MI	unverified
CITY OF BILLINGS	BILLINGS	MT	unverified
CITY OF CASPER BALEFILL	CASPER	WY	Municipal
CITY OF NEWCASTLE #2	NEWCASTLE	WY	Municipal
CITY OF	ECTOR COUNTY	Tx	unverified
CITY OF SUPERIOR	SUPERIOR	WI	Municipal
COWLEY COUNTY	WINFIELD	KS	Municipal
ELY LANDFILL	ELY	NV	Municipal
ET TECHNOLOGIES	SALT LAKE CITY	UT	unverified
FAIRBANKS N.STAR	FAIRBANKS	AK	Municipal
GLOUCESTER COUNTY	SWEDESBORO	NJ	Municipal
LAIDLAW MUNICIPAL	TYLER	TX	unverified
LINDEN MUNICIPAL	LINDEN	NJ	Municipal
MCPHERSON AREA SOLID	MCPHERSON	KS	Municipal
QUARRY LANDFILL	TULSA	OK	Municipal
RECOMP OF WASHINGTON	FERNDALE	WA	unverified
SOLDOTNA BOROUGH	SOLDOTNA	AK	Municipal
TUSCALOOSA WASTE	TUSCALOOSA	AL	Municipal
UNION COUNTY LANDFILL	SMACKOVER	AR	unverified
WAIMANALO GULCH	EWA BEACH	HI	Municipal
WASTE MANAGEMENT INC.	MONROE	LA	unverified
WASTE MANAGEMENT INC.	DENVER	CO	unverified
WAYNE DISPOSAL, INC	BELLEVILLE	MI	Municipal
WOOLWORTH ROAD	KEITHVILLE	LA	unverified

Subtitle C Landfills

NAME	CITY	STATE	VERIFICATION
AMERICAN ECOLOGY	ROBSTOWN	Tx	unverified
ASHLAND PETROLEUM	CATLETTSBURG	KY	Not a commercial landfill
BFI	MORGANTOWN	PA	unverified
CHEM MET SERVICES	WYANDOTTE	MI	unverified
CHEM-SECURITY SYSTEMS	ARLINGTON	OR	unverified
CHEMICAL WASTE	MODEL CITY	NY	Industrial C
CHEMICAL WASTE	CARLYSS	Tx	unverified
CHEMICAL WASTE	ARLINGTON	OR	Industrial C
COASTAL CHEMICAL	ABBEVILLE	LA	unverified
ENVIROSAFE SERVICES OF	OREGON	OH	Industrial C
ENVOTECH MANAGEMENT	BELLEVILLE	MI	unverified
GSX SERVICES OF SOUTH	PINEWOOD	SC	unverified
LAIDLAW ENVIRONMENTAL	WESTMORELAND	CA	Industrial C
LAIDLAW ENVIRONMENTAL	PECATONICA	IL	unverified
ROLLINS ENVIRONMENTAL	BATONROUGE	LA	Industrial C
ROMIC CHEMICAL CORP.	EAST PALO	CA	Industrial C
TEXAS ECOLOGISTS	ROBSTOWN	Tx	Industrial C
U.S. ECOLOGY	BEATTY	NV	Industrial C

Industrial D and Municipal Landfills

NAME	CITY	STATE	VERIFICATION
AMERICAN LANDFILL, INC.	WAYNESBURG	OH	Municipal
BFI	ALTA LOMA	Tx	unverified
HAZELWOOD LANDFILL	BAYTOWN	Tx	unverified
BFI	HOUSTON	Tx	unverified
WHEELER RECYCLING AND DIS	WHEELER	IN	unverified
PRAIRIE DISPOSAL, INC.	WILLISTON	ND	unverified
USPCI MINNESOTA INDUSTRIA	ROSEMOUNT	MN	Industrial D

Industrial D and C Landfills

NAME	CITY	STATE	VERIFICATION
BFI	SINTON	TX	unverified
BFI	ANAHUAC	Tx	Industrial D

CHEMICAL WASTE	EMELLE	AL	**Industrial** C
CHEMICAL WASTE	KETTLEMAN CITY	CA	**unverified**
CHEMICAL WASTE	CARLYSS	LA	**unverified**
CHEMICAL WASTE	SULPHUR	LA	**Industrial** C
LAIDLAW ENVIRONMENTAL	PINEWOOD	SC	**Industrial** C
LAIDLAW ENVIRONMENTAL	BUTTONWILLOW	CA	**Industrial** C
LWD, INC.	CALVERT CITY	KY	**unverified**
USPCI GRASSY MOUNTAIN	CLIVE	UT	**unverified**
USPCI LONE MOUNTAIN	WAYNOKA	OK	**Industrial** C

Industrial D and C and Municipal Landfills

NAME	CITY	STATE	VERIFICATION
CID LANDFILL	CALUMET CITY	IL	**Industrial** C
CHEMICAL WASTE	WALKER	LA	**unverified**
ENVIROSAFE SERVICES OF ID	GRANDVIEW	ID	**Industrial** C

4.0 Reported Receptor Well Locations at Refinery Landfills

EPA investigated survey responses for all facilities reporting a nonhazardous waste landfill. Approximately 172 facilities responded to the 1992 RCRA §3007 Survey of the Petroleum Refinery Industry. EPA determined that 27 of these facilities reported at least one onsite or captive offsite nonhazardous landfill. These landfills were used for the management of any waste reported in the survey, listing or study, in any year.

The survey specifically requested information regarding the distance from a waste management unit to the nearest private well in Table IX-4. Facilities also provided information relevant to land use and ground water characterization in response to other questions in Sections VIII through X of the survey. Of these 27 facilities, EPA found that only 15 reported the distance to the nearest drinking water well with any reliable documentation (e.g., maps showing private well locations, ground water flow gradients, company survey of wells reported). EPA's review of the data submitted with each of these 27 refineries is presented in Table 1.

Table 1. Well Distance Survey Response Information for Facilities with Nonhazardous Waste Landfills

Facility Name, Location	FACNO	RMUN	Distance to Private Well, feet	Data Reliability	Comment
Marathon Oil, Robinson, IL	48	8	>2,000	Unreliable	Maps do not provide any ground water or private well information. Map does show residences on west side of facility boundary.
Farmland Ind, Coffeyville, KS	56	801	>5,280	Reliable	Map does not show down gradient private well. Map shows ground water flow toward unoccupied crop land and away from residences.
Texaco, El Dorado, KS	57	2	16,000	Reliable	Maps show that ground water flows from the unit toward Salt Creek and then on toward agricultural land. The Survey notes that a study was made of private wells, and wells are listed (along with owners). The wells are not noted on the accompanying maps.
National, McPherson, KS	58	20	"None"	Unreliable	Survey indicates that there are no private wells down gradient. However, no supporting information is provided.
Ashland Oil, Catlettesburg, KY	60	9	"NA"	Unreliable	Survey states that there are surrounding wells but none are used for private drinking water. There is no supporting ground water flow information.
BP Oil, Belle Chase, LA	63	R2	"NA"	Unreliable	No discussion of ground water is provided. No private wells are indicated on accompanying maps. During the engineering site visits, no residences were viewed within one mile of the facility.
Shell Oil, Norco, LA	76	2	"NA" (>5,280)	Reliable	Survey reports no known drinking water wells or residences within one mile of facility. A detailed map shows a distance of over 6000 feet to nearest residences. Private wells are not indicated on the map. *Summary*--available information generally supports reported data.
Southland, Lumberton, MS	86	1	>5,000	Unreliable	No supporting data.
Amerada Hess Purvis, MS	88	20	"NA"	Unreliable	Ground water flow studies were done. The ground water flow is toward the southeast (rural area). However no mention of private wells is made. *Summary*--although documentation is provided there is insufficient discussion of private wells.
Southland, Sandersville, MS	89	1	>2,500	Unreliable	No supporting data.

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Table 1. Well Distance Survey Response Information for Facilities with Nonhazardous Waste Landfills

Facility Name, Location	FACNO	RMUN	Distance to Private Well, feet	Data Reliability	Comment
Amoco Oil, Mandan, ND	96	1	2,500	Reliable	Maps are included showing the location of private wells. Maps also show ground water flow and direction which supports the data. Down gradient private wells are clearly marked.
Amoco Oil, Mandan, ND	96	9	2,250		
Mobil Oil, Paulsboro, NJ	98	Ƹ	NA	Unreliable	Landfill is located 375 feet from the Delaware River with apparently no residence or wells between the facility and the river. Maps do not provide much detail beyond the facility perimeter. *Summary*--available information is insufficient to support reported data. However, if ground water flow is to the river, the data point would be reliable.
Bloomfield Refining, Bloomfield, NM	102	101	>2,000	Reliable	The survey notes that there are no private wells located in the gradient between the facility and the nearby San Juan River. The closest private well (2,000 ft) is located up gradient of the facility. *Summary*--based on available information it is unlikely that there is a private well within 2000 feet down gradient of the landfill unit.
Giant, Gallup, NM	10Ǝ	Ǝ1	26,800	Unreliable	Map is unreadable and provides no data describing ground water flow or surrounding wells. *Summary*--available information is insufficient to support reported data.
Total, Ardmore, OK	109	2	>26,400	Unreliable	Facility reports that there is only one household using a private well in general area. No other data is provided.
Conoco, Ponca City, OK	110	3	1,000	Reliable	Detailed maps showing private wells and ground water flow support this estimate.
Fina, Big Spring, TX	Ɛ2	13	3,500 or 2,500	Reliable	No information on private wells in area or ground water direction. Nearest residence is ~ 2,500 feet from landfill on map.
Phillips 66, Borger, TX	13Ǝ	45	8,970	Unreliable	Private wells are not marked on the maps. *Summary*--available information is insufficient to support reported data.
Southwestern, Corpus Christi, TX	138	9	None	Reliable	Ground water flow is generally toward Corpus Christi Harbor Shipping Channel and the to the Gulf of Mexico. Accompanying maps do not indicate residences in the direction of ground water flow. *Summary*--there are probably no private wells down gradient of the facility

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Table 1. Well Distance Survey Response Information for Facilities with Nonhazardous Waste Landfills

Facility Name, Location	FACNO	RMUN	Distance to Private Well, feet	Data Reliability	Comment
Chevron, El Paso, TX	141	501	>5,000	Reliable	Maps show closest private well at 5,600 ft. Note that this well is not in the direction of ground water flow. Data supports estimate.
Chevron, El Paso, TX	141	504	>5,000		
Chevron, El Paso, TX	141	503	>5,000		
Chevron, Port Arthur, TX	148	502	None	Reliable	Maps indicate that facility is about 2 miles from nearest residence. Surrounding area is swampland so private wells are unlikely. Data supports estimate.
Chevron, Port Arthur, TX	148	503	None		
Star Enterprise, Port Arthur, TX	150	401	No information	Unreliable	No information provided on private wells.
Diamond Shamrock Sunray, TX	153	210	9,000	Reliable	Maps show closest private drinking well at 9,000 ft. Data supports estimate.
Diamond Shamrock, Sunray, TX	153	240	9,000		
Phillips 66, Sweeny, TX	154	512	None	Reliable	Survey states that there are no water wells down gradient of the unit. Other residual management units at the facility are estimated to be four miles from nearest private well. Ground water flow information supports the estimate.
Amoco, Yorktown, VA	167	5	2,000	Reliable	Supporting map confirms estimate.
Hess Oil, St. Croix, VI	168	1	NA [None]	Reliable	The unit is about 50 feet away from Caribbean Sea. The sea is down gradient from the unit. The nearest private well, according to maps is 2,000 ft however, this well is up gradient (relative to ground water flow) to the unit. Available data supports estimate.
Sinclair Oil, Sinclair, WY	182	502	>26,400	Reliable	Sinclair reportedly performed research on private wells and concluded that there were no wells within 5 miles down gradient of their facility. However, accompanying maps are not sufficiently detailed to confirm this.
Sinclair Oil, Sinclair, WY	182	511	>2[illegible],400		
TOTAL: 27 facilities with nonhazardous waste landfills				15 reliable, 12 unreliable	

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5.0 Stabilization Technologies Used for K171/K172

EPA proposed to list as hazardous spent hydrotreating and hydrorefining catalysts (K171 and K172, respectively) at 60 *Federal Register* 57747 (November 20, 1995). When new, these catalysts are generally comprised of nickel, cobalt, and molybdenum (in percentage levels) on an alumina matrix. When spent, they can contain hydrocarbon in pore and void spaces, metal contaminants such as arsenic and vanadium (in ppm levels), and hydrogen or ferric sulfide. As site visit observations have shown and RCRA §3007 questionnaire data have substantiated, the spent catalysts are solid and have little to no free liquid (*Listing Background Document for the 1992-1996 Petroleum Refining Listing Determination*, October 31, 1995).

Several commenters (e.g., the American Petroleum Institute) stated that an on-site stabilization technique of cement addition is used in the industry to treat spent hydroprocessing catalysts. For these wastes, stabilization by cement addition is expected to serve the purpose of reducing the mobility of inorganic and organic constituents when placed in the ground, such as a landfill. Some of the effects of cement stabilization include the following (Jesse Conner, *Chemical Fixation and Solidification of Hazardous Wastes*, New York, Van Nostrand Reinhold, 1990):

- Precipitation of metals as insoluble species, such as hydroxides;
- Agglomeration of waste particulate matter in the cement matrix; and
- Solidification of the waste into a monolith to reduce the surface area exposed to leaching solutions.

There are many stabilization systems that use cement. Variations can be achieved in the presence and proportion of additives (such as lime, clay, and pozzolans) and process conditions (such as quantity of water, mixing and curing conditions, etc.). Unfortunately, data on such variations were not provided either in the RCRA §3007 responses or in the API comments. However, EPA does have data demonstrating the frequency that refineries stabilize K171/K172 wastes.

RCRA §3007 data show that six facilities managed K171/K172 using stabilization, in any year (these facilities are listed in Table 1). Subsequent to stabilization, all six facilities managed their waste in a landfill. This is consistent with the above observations concerning stabilization and its purpose of controlling the mobility of contaminants in a landfill. These six facilities do not necessarily all conduct cement stabilization; in fact, the stabilization method was unspecified. Stabilization data was only collected through the RCRA §3007 questionnaires; no stabilization techniques were observed during sampling trips and site visits.

When subjectively evaluating whether the use of stabilization is "widespread," it is important to remember that most refineries would not be expected to stabilize K171/K172. As stated in the proposed rule, over 75 percent of K171 and over 80 percent of K172 is recycled into regenerated catalyst or reprocessed to recover the various metals. For catalysts destined for recycling, the addition of cement provides no advantages and would make catalyst handling at the recycling facility difficult or impossible. Only the wastes destined for landfilling are expected to benefit from the effects of stabilization. Based on data presented in the *Listing Background Document*, 23 percent of K171 (47 of 201 wastes) and 11 percent of K172 (8 of 72 wastes) were landfilled in 1992 and would thus be "eligible" for stabilization.

Even when considering only landfilled K171/K172, stabilization is not widespread. Of the 55 K171/K172 wastes landfilled in 1992, Table 1 shows that only 2 were stabilized (less than 4 percent):

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Table 1. Stabilization of K171/K172, as Reported in RCRA §3007 Database

Facility and Waste	Year Generated	Treatment Train
Chevron, Richmond CA (K172)	1993	screen-->onsite stabilization-->offsite hazardous waste landfill
	1993	
Bayway, Linden NJ (K171)	1993	offsite stabilization-->offsite hazardous waste landfill[1]
Total, Ardmore OK (K171)	1993	offsite stabilization-->offsite industrial (nonhazardous) waste landfill[1]
Conoco, Ponca City OK (K171)	1989	onsite stabilization-->offsite hazardous waste landfill
	1986	
Valero, Corpus Christi TX (K172)	1992	Onsite stabilization-->offsite industrial (nonhazardous) waste landfill
Crown, Houston TX (K171)	1992	offsite stabilization-->offsite (unspecified) landfill[1]

1. Stabilization and disposal occurs at same location.

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